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OCTOBER 1966

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POTATO RESEARCH
Pages 5, 6, 7, 14, 15, 16

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AGRICULTURAL Research

October 1966/Vol. 15, No. 4

The Versatile Potato

The potato, the world's most common vegetable, has become one of the most versatile.

ARS research has had a part in this transformation.

Homemakers can now choose from about 50 processed potato products. For most of the 250 years since potatoes were first grown in this country, nearly all were sold fresh.

The switch to processed potatoes began in the early 1950's. The proportion of the nation's 400 million bushel crop used for processing grew from 13 percent in 1956 to more than one-third last year.

ARS developed many processed potato products now in grocery stores. Soon to be available commercially are potato dice produced by explosion-puffing—an ARS-developed process that makes dehydrated potatoes give up and take up water quickly and thus cook quickly (page 15).

As with all convenience foods, processed potatoes save time and work for homemakers. They save money, too, ARS nutritionists have found. These researchers compared preparation time, taste, and cost of dishes made with fresh and processed potatoes. Their conclusion: With 3 out of 4 recipes, a homemaker who values her time at 50 cents an hour or more is money ahead using processed potatoes (page 5).

Growers now raise potatoes "tailor-made" for specific uses. Varieties high in solids are used for potato chips; long tubers for french fries. Nearly all potatoes are harvested mechanically; automation also is used in storing potatoes.

ARS research has aided these and other advances. Recently, ARS researchers developed a machine that applies decay-preventing dust to cut seed potato pieces (page 14); a technique for sprouting seed pieces to get more plants per tuber (page 16); slotted fronts that withstand pressure from potatoes in above-ground storage bins and can be removed to permit machinery to enter the bins (page 15); and a refrigeration system for frost-free storage of tubers to be used for potato flakes (page 14). Research is underway to answer a question raised by potato chip manufacturers: Why do some chips turn an unappetizing dark brown when fried? (pages 6 and 7).

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Editor: R. P. Kaniuka

Managing Editor: H. K. Street

Contributors to this issue:

*C. E. Bower, H. L. Brinson,
Marshall Gall, D. W. Goodman,
M. E. Haun, M. B. Heppner,
J. G. Nordquist, N. E. Roberts,
D. F. Warren, D. M. Webb*

AGRICULTURAL RESEARCH is published monthly by the Agricultural Research Service, United States Department of Agriculture, Washington, D.C. 20250. Printing has been approved by the Bureau of the Budget, August 15, 1958. Yearly subscription rate is \$1 in the United States and countries of the Postal Union, \$1.50 in other countries. Single copies are 15 cents each. Subscription orders should be sent to Superintendent of Documents, Government Printing Office, Washington, D.C. 20402. Information in this periodical is public property and may be reprinted without permission. Mention of the source will be appreciated but is not required.

Orville L. Freeman, Secretary

U.S. Department of Agriculture

G. W. Irving, Jr., Administrator

Agricultural Research Service



Air Pollutants Combine to DAMAGE CROPS

TWO AIR POLLUTANTS—ozone and sulfur dioxide—can combine and damage plants before either pollutant alone would cause damage.

This finding, by ARS plant physiologist H. A. Menser and plant pathologist H. E. Heggestad, disproves the theory that the two pollutants act independently on leaf tissue.

Results of their test, the scientists say, may explain some of the air-pollutant damage to plants that occurs in the late spring and early fall when recorded levels of ozone and sulfur dioxide alone are not high enough to cause damage.

Heggestad and Menser also confirmed previous reports that sulfur dioxide can interfere with the operation of the Mast ozone meter, widely used to record ozone levels in the field, and found that the meter can be modified to overcome this problem.

Sulfur dioxide is largely a product of fuel combustion for power and heating. Concentrations tend to be highest in fall, winter, and spring. Ozone is one of a class of air pollutants called oxidants or photochemical smog formed by the reaction of sunlight on exhaust from motor vehicles. Levels of oxidants are generally highest during summer.

Both ozone and sulfur dioxide damage a wide variety of vegetable, field, and ornamental plants. The air pollutants reduce leaf quality of crops

such as tobacco and spinach; and cut yield of crops such as cereal grains, grapes, beans, and citrus fruit. The pollutants damage tree leaves and hinder development of ornamentals.

Growers can cut potential damage from air pollution to some extent by raising resistant varieties and species. Even these may be damaged in severe outbreaks.

For their research at Beltsville, Md., Menser and Heggestad used tobacco plants of varieties resistant and susceptible to ozone. Susceptible tobacco varieties are the most sensitive ozone indicators known. They show ozone injury, called weather fleck, in the field when concentrations reach or exceed threshold levels of 5 parts ozone in 100 million parts air (5 p.p.h.m.). At Beltsville and other locations, however, scientists had noticed symptoms resembling weather fleck when recorded concentrations of ozone were as low as 2 p.p.h.m. (1 grain of salt in over 1,600 gallons of water is a ratio of 1 p.p.h.m.)

The plant scientists exposed tobacco plants to single and mixed doses of ozone and sulfur dioxide in a walk-in fumigation chamber. The ozone dose was maintained near 3 p.p.h.m. and the sulfur dioxide averaged 25 p.p.h.m.—levels at which neither pollutant is expected to damage sensitive tobacco. Plants were exposed to the gases for periods of 2 and 4 hours.



Leaves of ozone-sensitive tobacco showed weather fleck symptoms after exposure to a mixture of ozone and of sulfur dioxide for 2 hours (top) and 4 hours. (Photos Nos. PN-1407 and PN-1408)

Technician G. H. Hodges checks the U-tube chromium trioxide scrubber which, when attached to the air inlet of the Mast ozone meter, prevents sulfur dioxide from interfering with ozone readings. (Photo No. ST-1374-24)



CROP DAMAGE (Continued)

No symptoms appeared when plants were exposed to the individual gases. When the gases were mixed, the typical symptoms of weather fleck appeared on the upper surfaces of the leaves. Injury was most severe on mature leaves. Total injury increased when exposure to the air pollutants was extended from 2 to 4 hours. Resistant plants were affected, al-

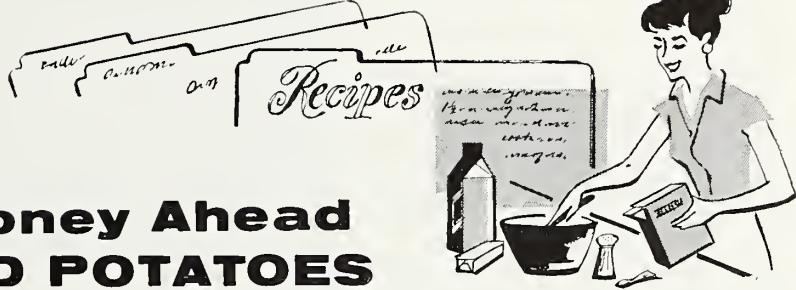
though not as much as plants of flea-susceptible tobacco varieties.

Injury to the tobacco plants occurred when levels of sulfur dioxide alone were maintained between 50 and 100 p.p.h.m. Concentrations of sulfur dioxide in the atmosphere seldom reach this high level, however.

In testing the Mast ozone meter, the scientists used a device called a U-tube

chromium trioxide scrubber to remove sulfur dioxide from the meter's air intake. When this device was removed from the meter during exposure to ozone and sulfur dioxide, the recorded ozone level immediately dropped from 3 p.p.h.m. to a constant level near 0 p.p.h.m. With the device in place, the meter recorded ozone levels accurately. ■

With 3 Out of 4 Recipes . . .



Homemakers Money Ahead With PROCESSED POTATOES

HOMEMAKERS WHO VALUE their time at 50 cents per hour or more will be money ahead preparing 3 out of 4 potato recipes with processed potatoes rather than fresh ones.

ARS food scientists at Beltsville, Md., reached this conclusion after comparing time and cost of preparation, palatability, and nutritive value of a variety of dishes prepared from processed and fresh potatoes.

Processed potatoes—canned, frozen, or dehydrated—continue to gain in popularity. USDA economists estimate that 35.1 percent of the 1965 U.S. potato crop was processed—nearly triple the 13.8 percent of the 1956 crop so used.

In their study, the ARS researchers found that less overall cooking time (minutes between starting to work and having food ready to serve) was needed for all dishes made with processed rather than fresh potatoes. Preparing frozen potato puffs, for example, took only 17 minutes. Starting with unpeeled potatoes, the job required 36 minutes.

Processed potatoes required less attention from the homemaker, too. Au gratin potatoes, for example, took only a minute of the homemaker's time when the frozen product was used. A recipe calling for fresh potatoes required 33 minutes. Whole frozen boiled potatoes were the only exception. They needed 9 extra minutes of watching because water took longer to return to a boil when frozen potatoes were added.

A taste test panel rated most of the dishes made from processed potatoes as tasty as dishes made from fresh potatoes. The panel noted differences in palatability between brands of dehydrated potatoes, and, to a lesser extent, in frozen french fries.

In nutritive value, processed and fresh potatoes were basically similar. Dishes prepared from dehydrated mixes, including au gratin, scalloped, and hash-brown potatoes and potato soup, had higher carbohydrate and mineral content and lower protein content than fresh potatoes. This difference is not critical because potatoes

are not a major source of protein in U.S. diets.

The scientists also found that processed-potato products varied more in nutritive value within the same brand than between brands; within-brand variations were also greater than differences between processed and fresh potatoes.

The major nutritive difference between products tested was the amount of fat potatoes take up while frying. French fries prepared from fresh potatoes, for example, contained about 9 percent fat when served; frozen french fries reheated by frying contained 19 to 28 percent fat. Frozen french fries reheated in the oven contained 8 to 16 percent fat, with crinkle-cut and regular forms of french fries at the low end of the range and shoestring forms at the high.

Chief participants in the ARS study were food specialists P. L. King, G. L. Gilpin, and E. H. Dawson; and analytical food chemists E. W. Murphy, A. C. Marsh, K. E. White, and S. N. Hagan. ■

Laboratory assistant Hilda Martin thaws frozen potatoes, one of the types of processed potatoes used in comparison tests with fresh potatoes at Beltsville, Md. (Photo No. ST-1374-2)



POTATO

What Causes Dark Potato Chips?

AMERICAN CHEMISTS ARE producing simulated potato chips by "frying" paper disks in deep fat.

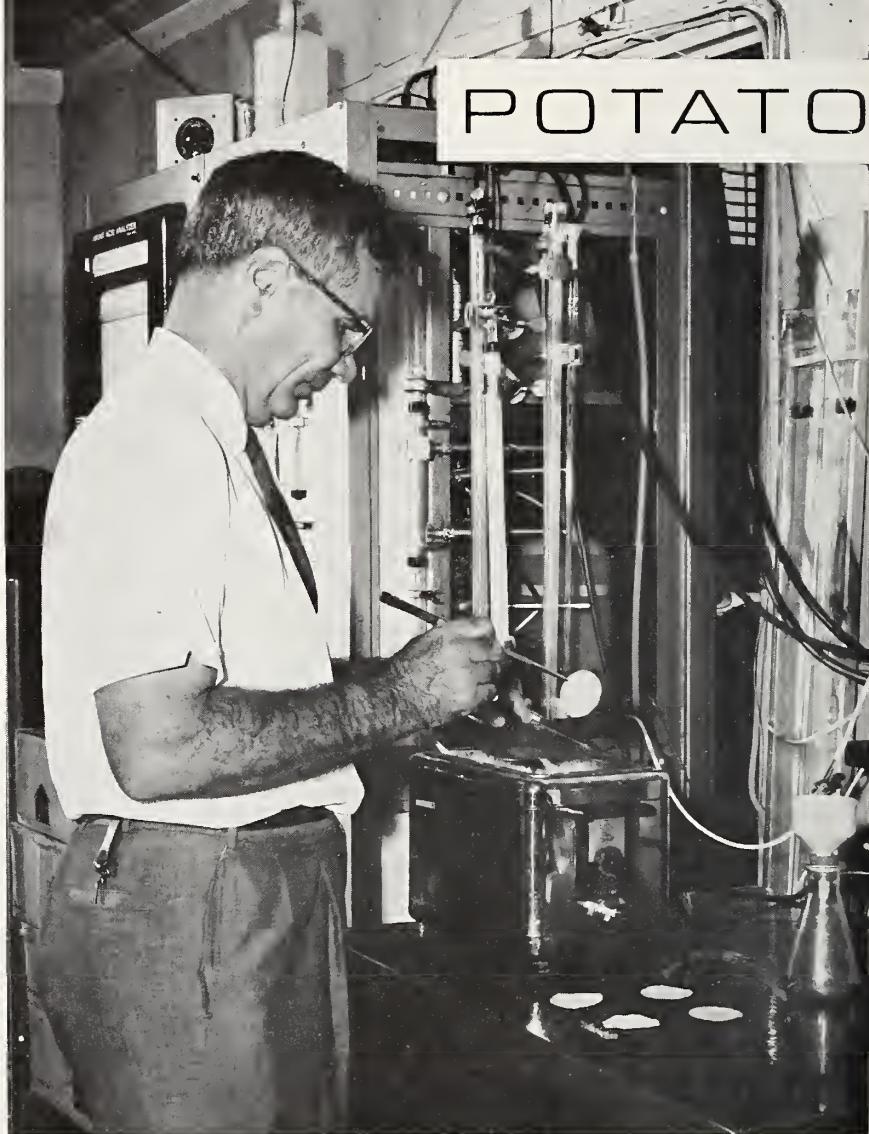
They are trying to learn why some potato chips turn a dark, unappetizing brown color while they are being fried—a costly problem to chip processors.

The chemical reactions that cause browning in fried foods like potato chips are highly complex. Food scientists who have studied these reactions for more than 50 years have learned that browning results from heating certain sugars in the presence of amino acids, the building blocks of protein. Potatoes contain widely varying amounts of different sugars—depending on their variety, growth conditions, and time and temperature of storage—and contain as many as 27 different amino acids.

Since potatoes are too complex, scientists use models to investigate the browning produced by heating individual sugars with different amino acids. One model is a disk of filter paper which, if impregnated with a single sugar and one or two amino acids, will brown just like a potato chip fried in deep fat.

Chemists E. A. Talley and W. L. Porter, of the Eastern utilization research laboratory in Philadelphia, have taken this technique one step further. They not only measure the color formed in the disks but subject the disks themselves to chemical analysis to find out what compounds are formed by the reaction responsible for the brown color.

In their tests so far they have used one sugar, mainly glucose, and several amino acids, one at a time. They heat the impregnated disks in deep



Chemist E. A. Talley removes filter paper disks "fried" in deep fat. The disks will be analyzed in automatic amino acid analyzer. (Photo No. PN-1409)

fat at a constant temperature for varying periods of time, and then chemically analyze the amino acid.

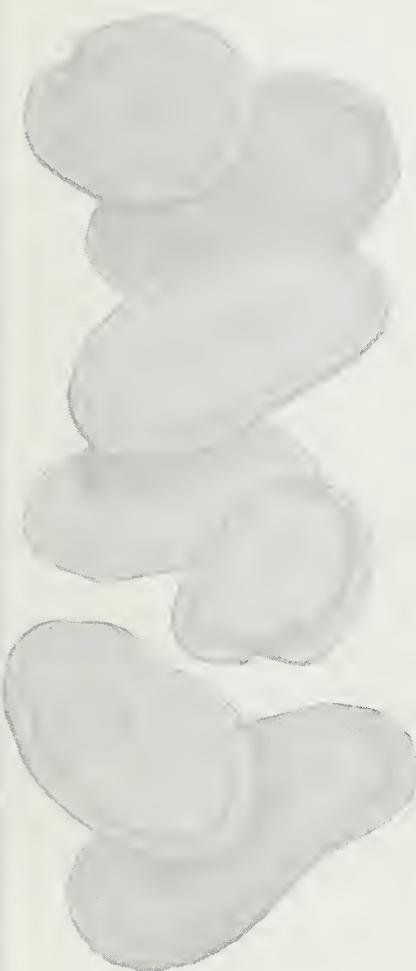
These analyses have shown that the sugar and amino acid react very quickly, sometimes even without heat. After very brief periods of heating, the amino acid originally applied to the disk practically disappears, and it is replaced by other compounds which are apparently intermediate to the

final product that causes browning.

Talley and Porter are now seeking to isolate and identify these intermediate compounds as a preliminary step to identifying the final product. If they can identify the intermediate compounds, they hope to have a clue as to what the final browning product is, and how its formation can be controlled for the consistent production of rich, golden potato chips. ■

RESEARCH . . .

Can Browning be Prevented?



ARS SCIENTISTS ARE learning why potatoes taken from cold storage are more likely to turn an objectionable dark brown color when made into chips or french fries than potatoes stored at higher temperatures.

This browning is caused by a reaction between reducing sugars in potatoes and the amino acids. Cold storage, which keeps potatoes firm and prevents sprouting, also favors

the accumulation of these reducing sugars.

ARS chemist Russell Pressey and food technologist Roy Shaw, at the Red River Valley Potato Processing Laboratory, East Grand Forks, Minn., have helped to clarify the mechanism by which this sugar formation occurs under different storage temperatures, and have confirmed that the level of reducing sugars in potatoes can be lowered or raised by raising or lowering storage temperature.

With this knowledge, they hope to develop some biological control mechanism that will prevent or retard the development of reducing sugars under the low temperatures at which potatoes must be stored.

Pressey and Shaw analyzed one lot of potatoes kept for 30 weeks in cold storage (40 degrees F.) and another kept for 11 weeks at slightly less than room temperature (65 degrees F.). They also analyzed potatoes that had been shifted back and forth between the two temperatures.

They were especially interested in the way storage temperature affects the competition inside a potato between two of its chemical constituents. One, an enzyme called invertase, converts sucrose (a nonreducing sugar) to glucose and fructose (reducing sugars).

Since the reducing sugars are implicated in browning, invertase indirectly lowers the processing value of potatoes. But this enemy of processing quality has itself an enemy, an inhibitor that prevents invertase from converting sucrose to the reducing sugars.

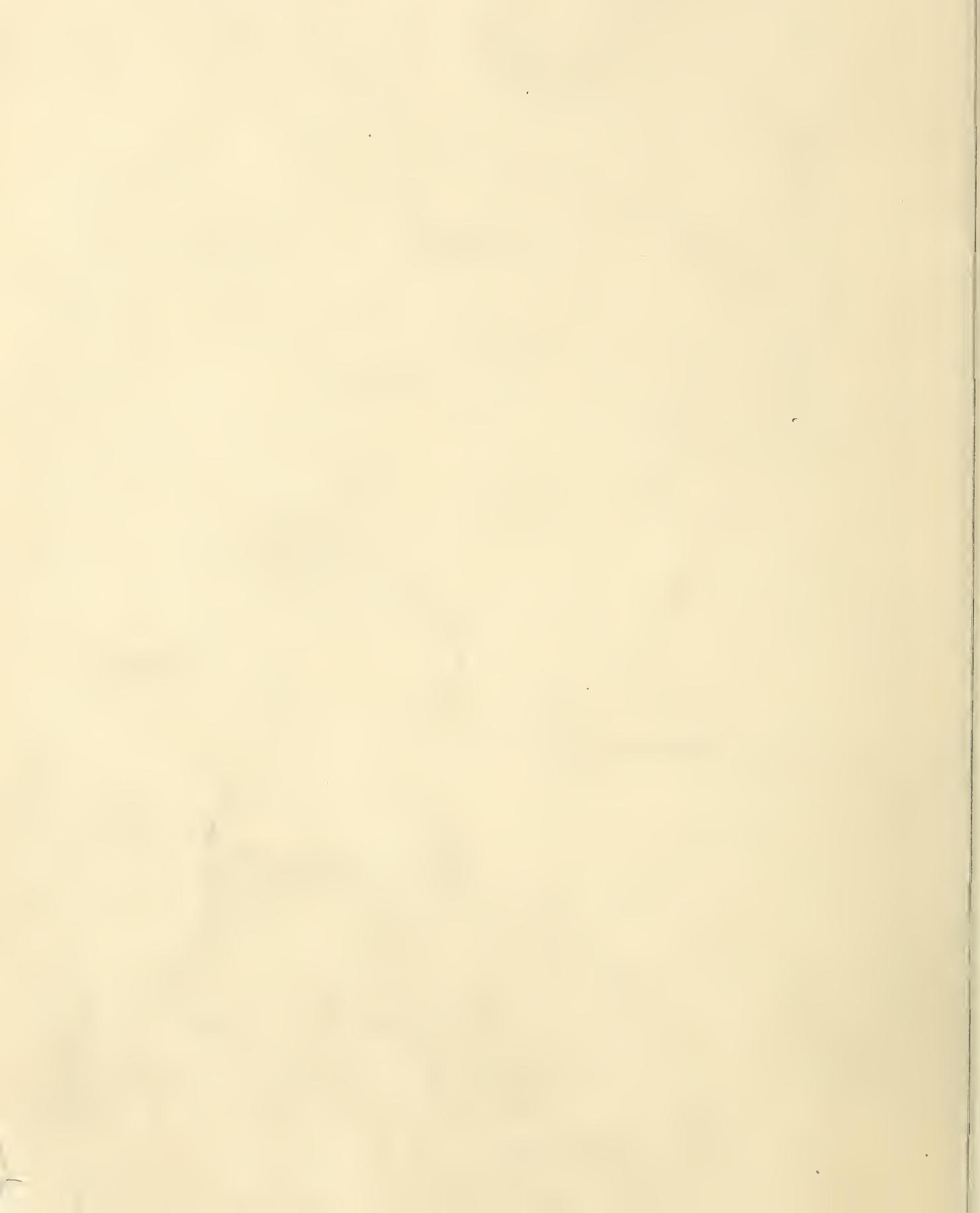
Pressey developed an assay method for both invertase and its inhibitor.

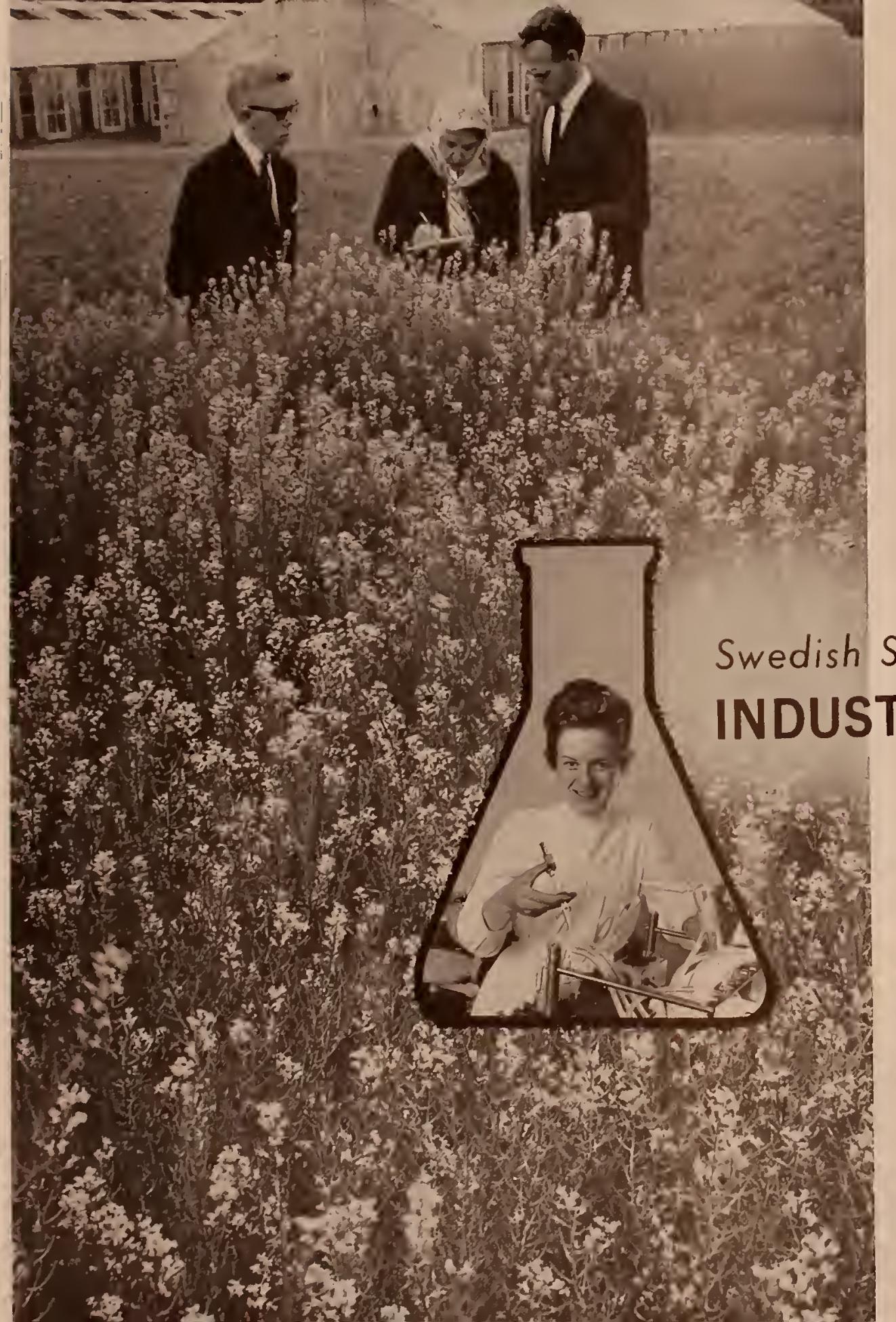
Using this method, he showed that during the first few weeks of cold storage reducing sugars accumulate under the action of invertase. Eventually the enzyme activity reaches a maximum. Then the inhibitor begins to form and there is a leveling off in the amount of reducing sugars in the potatoes.

Moving the potatoes from cold storage to a higher temperature causes a rapid buildup of the inhibitor, resulting in a sharp decline in the activity of the invertase and a lowering in the content of the reducing sugars. Pressey and Shaw demonstrated that this reaction is completely reversible, as they shifted the potatoes back and forth between the two storage temperatures and noted that at the high temperature an excess of the inhibitor kept the content of both invertase and reducing sugars low, while the reverse was true at the lower temperature.

Their findings, Pressey and Shaw say, suggest the possibilities of breeding potatoes with less invertase or more inhibitor; the use of chemicals that will depress the activity of invertase or stimulate that of the inhibitor; and development of means of controlling the level of the sucrose from which reducing sugars are formed.

The Red River Valley Potato Processing Laboratory, established in 1965, is on the grounds of the Red River Valley Potato Research Center at East Grand Forks. There, studies on potato production, harvesting, storage, and handling have been carried out cooperatively since 1948 by the Red River Valley Potato Growers Association, North Dakota and Minnesota Agricultural Experiment Stations, and ARS. ■





Swedish Scientists Develop Oilseed Crops for... INDUSTRY IN U.S. ★ FOOD IN SWEDEN

S WEDISH SCIENTISTS ARE giving a big assist to the work of researchers in this country toward oilseed crops high in erucic acid for industrial use.

And, as a byproduct of their research, the Swedes are also working toward crops low in erucic acid for possible use as food in their own country.

Oils high in erucic acid have unique properties that make them valuable in industry. An erucic-acid oil, for example, is used to lubricate molds used in continuous casting of steel.

The work toward crops high in erucic acid is supported by a Public Law 480 research grant, awarded by ARS to the Swedish Seed Association in Svalov in 1963. Such grants are made from local currencies paid by countries that receive U.S. surplus food under P.L. 480.

Chief investigator Lars-Åke Appelqvist, chemist at the Swedish Seed Association, and plant geneticist Bengt Lööf are determining the erucic acid content of established inbred strains of plants in the mustard family—rape, turnip rape, and white mustard.

When they find a strain naturally high in erucic acid,

they try to breed for an even higher content for possible use in the United States. They also search for strains low in erucic acid for Swedish needs.

Their most marked breeding success to date has been with white mustard. With this plant, they have obtained lines varying in erucic acid content from 15 to 58 percent.

They have bred strains of winter rape with about 60 percent erucic acid and spring turnip rape with 59 percent.

In addition to their breeding program, the Swedish scientists are determining the potential of wild plants in the mustard family as possible oilseed crops. Here, they find the plant *Barbarea vulgaris* most promising. It is only intermediate in erucic acid content, with 30 to 40 percent; but it is insect resistant, frost-hardy, and not killed by standing water.

Recently, Appelqvist and Lööf included crambe in their breeding project. The first mustard-family plant grown experimentally as a high erucic acid oilseed crop in the United States, crambe has a natural erucic acid content of up to 59 percent and has grown well in experiments in this country. ■

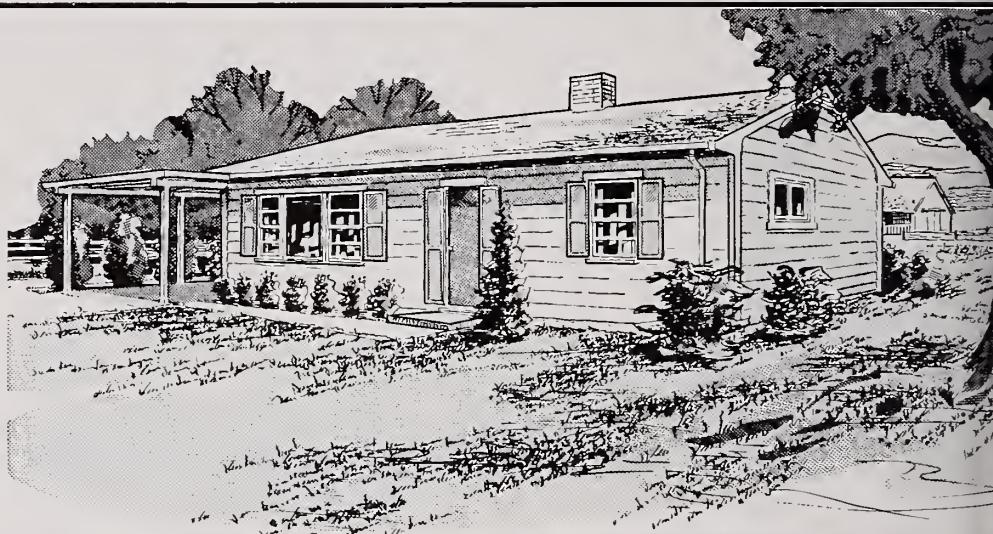
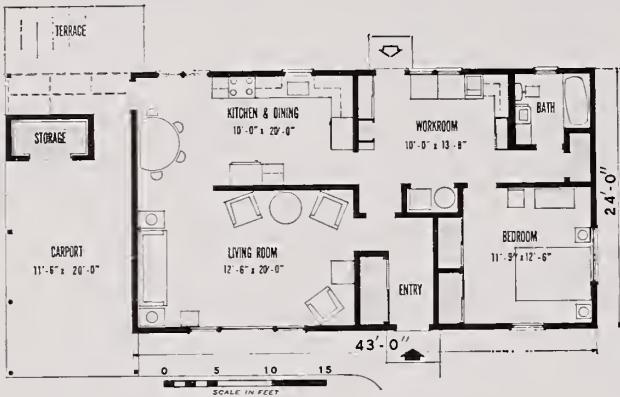
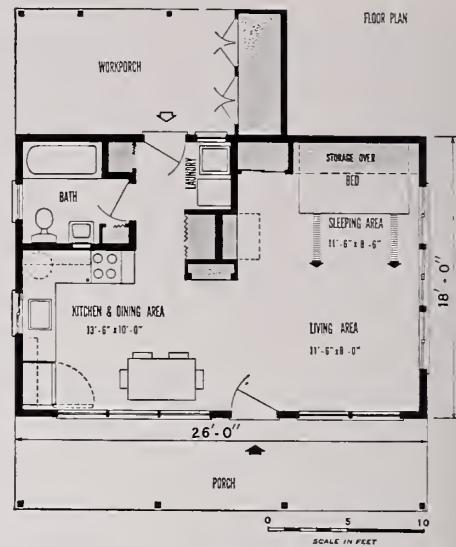
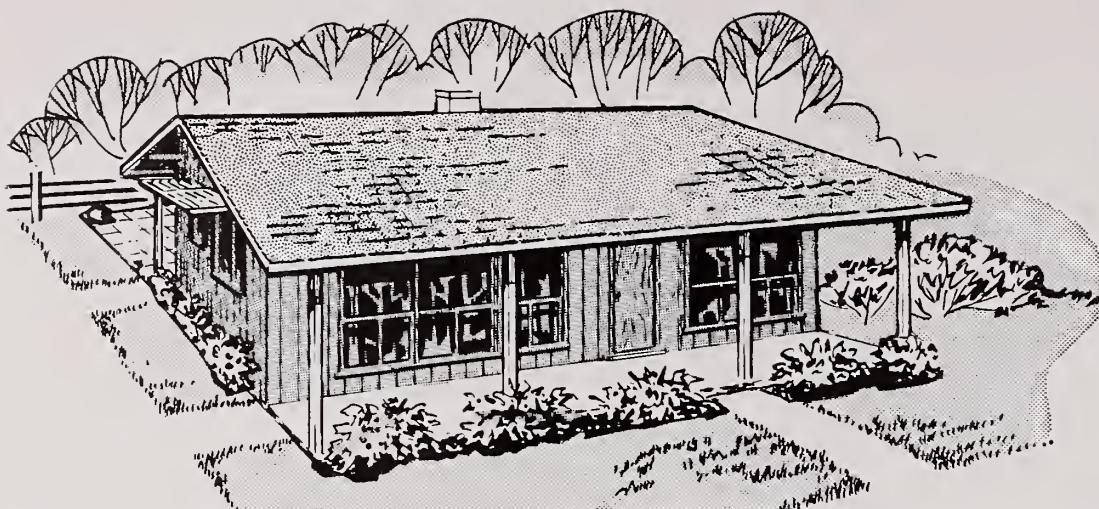
Left—Lars-Åke Appelqvist (left) and Bengt Lööf (right) explain breeding work with a wild strain of *Barbarea vulgaris* (foreground) to M. E. Haun, ARS public information officer. (Photo No. PN-1410)

Left Inset—Gunnar Ahlberg prepares fatty acid esters from seed. (Photo No. ST-1166-11)
Near Right—Bengt Lööf and Appelqvist discuss chromatogram from a chromatograph used in erucic acid testing. (Photo No. ST-1167-4)

Right Center—Appelqvist holds seeds of mustard-family crops from which he extracts oil to be tested for erucic acid content. (Photo No. PN-111)

Far Right—This strain of *Barbarea vulgaris* shows the most promise of wild mustard-family plants. Lööf has screened it and grown it for 4 years without breeding. (Photo No. ST-112)





Plan No. 7154—This one-bedroom farmhouse provides 1,032 square feet of living space. The rectangular house is frame with concrete slab floor and trussed roof. The center hall provides good circulation to all areas—ideal for those in wheelchairs. The L-shaped kitchen has ample space for preparing food; it is close to the terrace for convenience in serving meals outdoors. Groceries can be easily carried from the car to storage facilities. The bedroom with bath nearby is sound-cushioned from the entrance hall by closet walls. To save time, steps, and energy, the workroom is located near the kitchen, bathroom, and rear entrance. Here a retiree can hang his coat and wash up before entering other areas of the house. A place for sewing and other hobbies, the workroom may also serve as a play area for grandchildren. Workroom and kitchen windows are arranged so that occupants can easily see outside. A second bedroom could be added with entrance through space now occupied by the linen closet, between the bathroom and present bedroom. (Photos Nos. PN-1412, PN-1413)

Plans Based on ARS Research . . .

FARM HOMES FOR SENIOR

HOUSES THAT MEET the needs of senior citizens have been designed by ARS housing specialists.

Their plans—based on research on living habits of older people (AGR. RES., July 1964, p. 14)—are designed to provide housing that is safe, healthful, and stimulating for older people without constantly reminding them of age and infirmities.

A house built according to the ARS plans would be particularly suitable for a retired couple who want to stay on the farm, but do not want to live in a big, old farmhouse. Such retired farmers and other senior citizens often want to stay in the rural areas where

they worked during their lifetimes, but have difficulty finding adequate and suitable housing.

In their plans, the housing specialists at Beltsville, Md., included safety features to prevent accidents caused by poor vision, unsteadiness of hand, unsureness of gait, and lack of balance. Examples are grab bars around bathtubs and toilets, securely mounted towel racks and rods, uncluttered passageways, and plenty of natural light.

No shelf is higher than 68 inches or lower than 12 inches from the floor. Doorways are from 32 to 36 inches wide (to accommodate a wheelchair) and bathrooms are large enough so

Plan No. 7148—This farm cottage is designed to provide 468 square feet of living space and an additional 289 square feet for a work porch and storage area. This is a solar-type unit designed to take advantage of the heat of the sun with a specially designed roof overhang that lets sunshine through the south windows in the winter but not in the summer. The kitchen area, although small, is conveniently arranged and has ample storage space. The dining area is located near a large window and would be especially pleasant with a good view. The sleeping area is large enough, too, so the bed can be made easily from either side. The area could be curtained or partitioned for privacy. The rest of the living area is large enough for the usual living room furnishings. The bathroom is large enough so that one person can help another without interference from the fixtures. The dining area is convenient to both the living area and the bath. (Photos Nos. PN-1414, PN-1415)

CITIZENS

that one person can help another without interference from the fixtures.

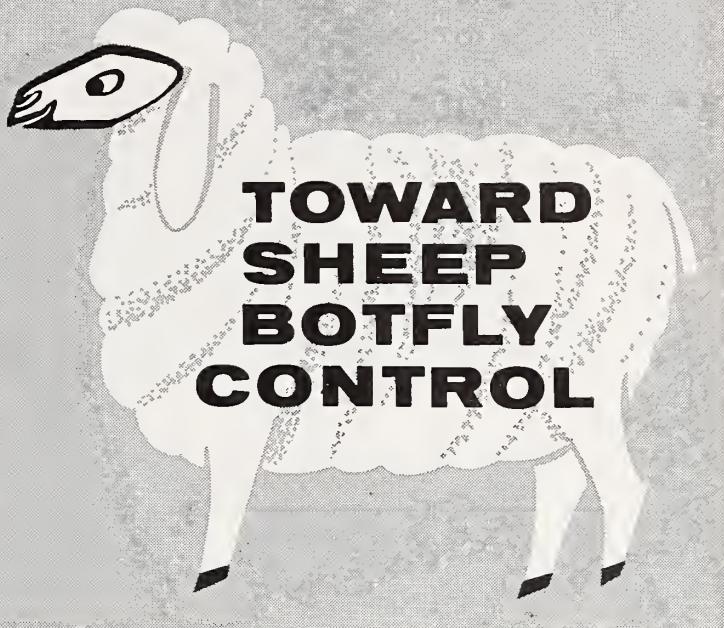
Working drawings of these plans (No. 7154 "One Bedroom Farmhouse" and No. 7148 "Solar-Type Farm Cottage") can be obtained from extension agricultural engineers at State universities. There is usually a small charge. USDA does not distribute working drawings.

Agricultural Information Bulletin No. 297, "Retirement Housing for Rural Areas," has other suggestions and can be obtained from the Superintendent of Documents, Government Printing Office, Washington, D.C. 20402 for 20 cents per copy. ■

*Insecticides
Control
Infestations*

*Safety Tests
Underway*

TOWARD SHEEP BOTFLY CONTROL



APPLYING SYSTEMIC INSECTICIDES to sheep in the fall can sharply reduce botfly infestations, ARS researchers have found.

Scientists at the ARS Toxicological Research Laboratory, Kerrville, Tex., are now determining whether the experimental insecticides are safe for use on sheep of many breeds, in different environments, and on different rations. And scientists at the University of Kentucky, Lexington, supported by an ARS grant, are studying the insecticides under conditions faced by Eastern sheep raisers.

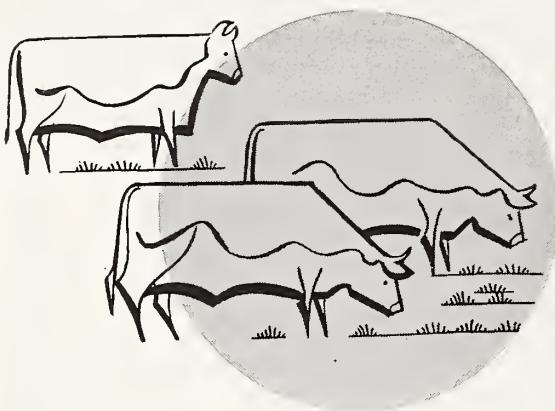
The sheep botfly, *Oestrus ovis*, causes heavy losses wherever sheep are raised and causes about one-third of sheep losses from insects in the United States. Sheep are terrified of the small fly, which deposits its young in the sheep's nostrils where they grow and mature. There, they cause irritation, abscesses, poor feeding, unrest, and sometimes death.

Research entomologist R. O. Drummond at the ARS Livestock Insects Investigations Laboratory at Kerrville and research veterinarian W. P. Meleney at the ARS Parasite Research Laboratory, Albuquerque, N. Mex., found that six experimental insecticides—called Bayer 37341, Bayer 37342, famophos, ruelene, dimethoate, and Stauffer R-3828—drastically reduced botfly populations.

All six can be administered by mouth; and ruelene can also be poured onto sheep. Since it is easy to apply and effective, the scientists believe that ruelene, applied in the fall when botfly larvae are dormant, would be practical for controlling the pest if proved safe under all conditions.

In their toxicological studies with the most promising insecticides, research veterinarians R. D. Radeleff, R. L. Younger, J. S. Palmer, and R. T. McCarty and chemist Donald Clark will try to determine the reaction of these chemicals on wool, whether the insecticides leave any residues in the animal's body, and if they react with some portion of the sheep's diet to produce harmful effects.

Studies at Kerrville and the Kentucky research will attempt to answer another question: Will sheep in humid climates react in the same way as sheep in arid areas? ■



HIGHER BEEF GAINS POSSIBLE WITH BERMUDAGRASS CROSSES

CATTLE THAT GRAZE the highly nutritious Coastal bermudagrass pastures of the Southeast may one day find their fare much tastier, but they won't be around as long to enjoy it.

Researchers have found that the dry-matter digestibility of Coastal bermudagrass can be increased significantly, leading to higher daily beef gains and earlier marketing. In one case, the scientists raised bermudagrass digestibility enough to give a theoretical increase of 30 percent in daily gains.

Geneticist G. W. Burton and agronomist R. H. Hart, both of ARS, and animal scientist R. S. Lowrey and biochemist W. S. Wilkinson, of the

Georgia Agricultural Experiment Station, working at Tifton, Ga., produced 14 hybrids by crossing the Coastal variety with two other bermudagrasses from Africa. They compared forage samples from each hybrid with similar samples from Coastal bermudagrass at various stages of growth.

The best hybrid—a cross between Coastal and a line from Kenya—had an average digestibility of 58.1 percent, compared to 51.8 percent for Coastal bermudagrass.

To predict increases in daily gain, the scientists assumed that dry-matter digestibility percentages are closely related to the total digestible nutrient content of the forage.

Coastal bermudagrass with 51.8 percent digestibility would provide an average daily gain of 1.13 pounds per animal in addition to daily maintenance, the scientists say. In contrast, the hybrid would yield a daily gain above maintenance of 1.47 pounds per animal—30 percent more than Coastal.

Although early results are promising, the researchers must learn still more about these bermudagrass hybrids from actual feeding trials. They also want to improve the cold resistance of some of the hybrids, since the best is susceptible to winter damage in areas north of Tifton. ■

Similar Lesions - Different Causes

Pulmonary adenomatosis of cattle produces lung lesions similar to those caused by silage gas poisoning in man, but ARS research veterinarian R. C. Cutlip has found that these two diseases have different causes.

Silage gas poisoning affects farmworkers filling silos or working around silos during the first few days after filling. It is caused by inhaling the nitrogen dioxide given off in some cases by fermenting silage.

The similarity of lung lesions in the

two diseases led to the idea that pulmonary adenomatosis, a disease that generally occurs in feedlot animals shortly after a change in ration, may also be caused by nitrogen dioxide. The change in ration was thought to produce excessive nitrogen dioxide in the rumen which was then belched and enough of it inhaled to cause the lung lesions.

In experiments at the National Animal Disease Laboratory, Ames, Iowa, Cutlip forced cattle to inhale nitrogen

dioxide. This produced lesions similar to pulmonary adenomatosis.

When he introduced the gas into the rumens of other cattle, however, only minor lung lesions developed, probably because the gas was rapidly decomposed in water in the rumen before it could be belched.

In future research, Cutlip hopes to find out if another toxic gas is produced in the rumen during abnormal fermentation and if it is involved in the cattle disease. ■



NEW FORAGE HYBRID



From Pearl Millet Napiergrass Cross

SOUTHEASTERN CATTLEMEN may soon raise a new hybrid forage that provides high yields from midsummer until late fall.

Produced by crossing pearl millet, a common summer annual crop, with napiergrass, a tropical bunchgrass, the new hybrid yields as well as Gahi-1, the highest yielding pearl millet variety.

Pearl millet (Photo No. PN-1416), the best summer annual forage now grown by Coastal Plain farmers, makes most of its yield during a short part of the growing season.

Napiergrass (Photo No. PN-1417) also makes high yields, but has had limited acceptance by cattlemen because it usually must be propagated from stem or crown cuttings. Its seed is difficult to harvest and produces weak seedlings.

Plant breeders have crossed pearl millet and napiergrass experimentally for some time, but the crosses were not practical for commercial use because seed had to be produced by hand pollination.

ARS geneticists J. B. Powell and G. W. Burton overcame this problem in producing their new hybrid by using a male-sterile pearl millet variety, Tift 23A, as the female parent. The male-sterile plants do not produce their own pollen, and therefore cannot produce seed unless pollinated from another source.

Powell and Burton sowed Tift 23A between rows of Merkeron napiergrass, the male parent for their cross. Pollen from the napiergrass reached the pearl millet, and the scientists harvested hybrid seed.

Since napiergrass is a perennial, it isn't necessary to establish it every year. This, the scientists point out, would cut costs in seed production.

In trials in cooperation with the Georgia Experiment Station at Tifton, Powell and Burton compared yields of the new hybrid and Gahi-1 harvested in late July, early September, and mid-November.

While total season yields were nearly the same, the hybrid produced 14 percent of its total yield in July, 57 percent in September, and 29 percent in November. Gahi-1 produced 56 percent of its total yield in July, 40 percent in September, and only 4 percent in November.

The scientists believe the hybrid is hardier than pearl millet which kills at temperatures near 32° F. In an earlier test at Tifton, 60 percent of an ungrazed hybrid plot survived a few hours of 15° F. temperatures.

The new hybrid, still unnamed, is not yet ready for commercial use. Powell and Burton are now learning more about its management requirements and forage quality. ■

NITROGEN ON GRASSLAND

*Applied in Drought—
Available With Rain*

Grassland responds well to nitrogen fertilizer during wet years, but in dry years . . . what? The question has long discouraged farmers from fertilizing grassland in the Northern Great Plains where rainfall is erratic.

Recent ARS research indicates, however, that nitrogen applied to grassland remains in the soil during a dry year, insuring efficient use of moisture when rains come.

ARS soil scientist J. F. Power at Mandan, N. Dak., found that up to 65 percent of the soluble nitrogen applied to unirrigated testplots was available to grass the following season.

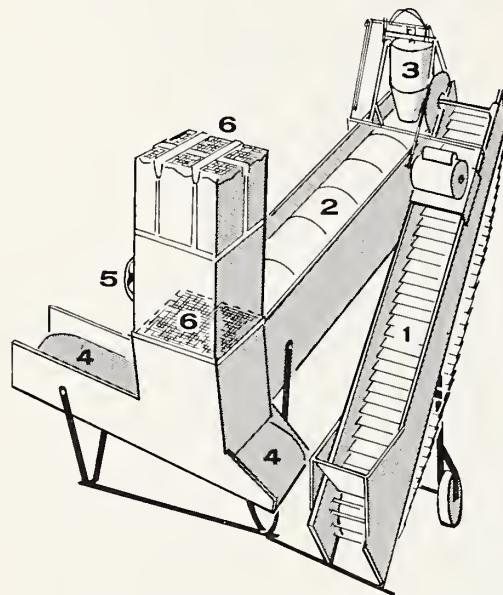
Power established bromegrass on fine, sandy loam, and fertilized with calcium nitrate. Irrigated and unirrigated plots each received the following treatments: 180 pounds of nitrogen per acre in early spring, before plant growth began; 90 pounds per acre in early spring plus 18 weekly applications of 5 pounds each during the growing season; and 10 pounds per acre during the summer in each of 18 weekly applications.

Soluble nitrogen content in the irrigated soil declined rapidly as the nitrogen was absorbed by growing plants. In the unirrigated soil, however, soluble nitrogen content remained relatively stable. During periods of drought, it even rose beyond the level attributable to applied nitrogen, possibly because nitrogen-producing bacteria increased in the soil.

Plots that received all their fertilizer in weekly applications retained nitrogen best. Next best were those that received half the total fertilizer in the spring, and the other half in weekly applications. ■

POTATO RESEARCH

DUSTER PREVENTS SEED-PIECE DECAY



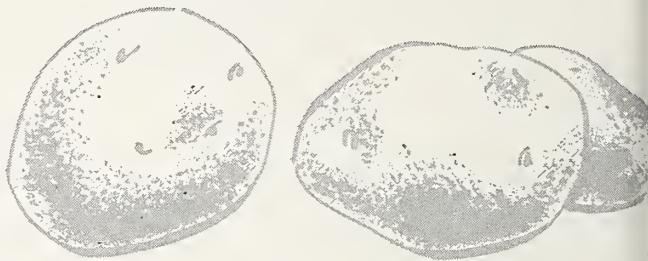
An experimental machine that applies decay-preventing dust to pieces of cut seed potatoes has been developed by ARS agricultural engineer G. W. French, at the Red River Valley Potato Research Center, East Grand Forks, Minn.

When adapted for commercial use, the machine could save growers \$50 or more per acre lost from poor stands that result when adverse soil moisture and temperature at planting time cause potato seed pieces to decay.

While dust formulations protect potato seed pieces against decay, some methods and equipment now used do not apply dust evenly to the cut surfaces. The dust may also diffuse into the atmosphere of the work area, where it is a potential health hazard.

French's machine overcomes these problems. In tests during the 1965 and 1966 planting seasons, the unit applied dust evenly and adequately and confined the dust within the machine.

The experimental machine consists of: (1) a conveyor for continuous feeding of cut seed pieces, (2) a rotating drum in which the seed pieces are coated, (3) a hopper and dust-metering device, (4) a short belt conveyor for removing the treated pieces, (5) a fan for drawing air into the box that encloses the rotating drum, and (6) a cloth filter through which air is exhausted from the system. (Photo No. PN-1418) ■



FROST-FREE STORAGE

Processors of potato flakes may soon be able to store potatoes more cheaply and easily with an ARS-developed refrigeration system.

The refrigerator unit operates free of frost. Thus, it eliminates the heat and moisture that damage potatoes when ordinary refrigerators are defrosted. Because it is frost-free, it maintains a constant temperature over long storage periods—up to 9 months in tests.

Agricultural engineers L. A. Schaper, E. C. Yaeger, and W. A. Junnila, all of ARS, and A. M. Flikke, of the University of Minnesota, designed and tested the system at the Red River Valley Potato Research Center, East Grand Forks, Minn.

Fall crop potatoes from this area are commonly stored below ground. Recently, however, growers and processors have been interested in aboveground facilities where storage costs and potato damage are less, and handling is easier than in underground bins. Aboveground storage sacrifices the natural insulation of the earth, so mechanical refrigeration is necessary, especially during late spring and early summer.

The experimental refrigerator unit has an oversize evaporator that operates with a temperature difference of only about 5 degrees between the air and refrigerant. This prevents frost from forming on cooling coils.

To test the unit, researchers stored six varieties of potatoes—Bounty, Irish Cobbler, Kennebec, Norgold, Red Pontiac, and Snowflake—for periods up to 9 months, at temperatures of 40, 45, and 50 degrees F. and at relative humidities above 75 percent.

Potatoes stored at all temperatures produced acceptable flakes. Those processed directly from storage at 50 degrees produced white flakes more consistently. ■

NEW FRONTS FOR BINS



EXPLOSION-PUFFING

Quick-cooking dehydrated potato dice for soups and stews and potato slices to be served scalloped or au gratin may soon be available commercially.

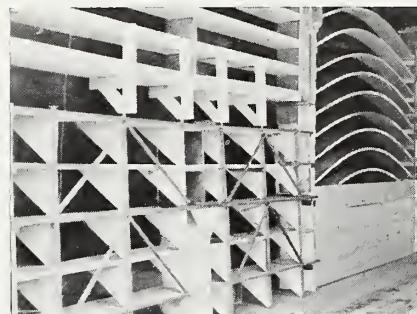
They can be produced by explosion puffing, a process that reduces the cooking time of dehydrated pieces of fruits and vegetables from a half hour or more down to 5 or 6 minutes or less (AGR. RES., April 1964, p. 3). The process is already in limited use with carrots.

In explosion puffing, the pieces are dehydrated normally. After partial drying, they are exploded from a puffing gun which has little effect on the size and shape of the pieces, but gives them a porous structure. Thus, when returned to the dryer, the pieces readily give up remaining water. Just as readily, the dehydrated pieces take up water when they are reconstituted—the secret of their quick-cooking properties.

Scientists at the ARS Eastern utilization laboratory in Philadelphia, where explosion puffing was developed, recently designed a new puffing gun. Superheated steam is passed through the barrel, speeding the puffing operation.

Explosion-puffed potato slices can be served as boiled potatoes or made into potato salad after simmering for 5 or 6 minutes. Simmered 3 or 4 minutes, drained, and put into a casserole, the slices can be served scalloped or au gratin after 10 minutes' baking.

Estimates based on pilot-plant operation of the process indicate that explosion puffing would cost a processor about 3 cents a pound more than conventionally dehydrated potatoes. Prospective processors can obtain samples and more information about the process from ARS' Eastern Utilization Research and Development Division, Philadelphia, Pa. 19118. ■



Of various potato bin fronts tested, a slotted front (upper left) has shown the most promise. (Photo No. PN-1419)

America's pioneer farmers stored their potato harvest underground; so did succeeding generations of potato growers. Now potato storage has moved above ground and has become mechanized.

One remaining bottleneck to full mechanization—narrow openings into individual storage bins that restrict movement of equipment—may be eliminated with new bin fronts being developed by ARS agricultural engineers P. H. Orr and E. C. Yaeger.

Pressures, sometimes as great as 100 pounds per square foot, that can bulge or burst open bin fronts are the main reason why wide, removable fronts have not been used in many storage facilities. The new bin fronts are strong, lightweight, low in cost, and can be stored easily. When they are removed, equipment can maneuver easily through 20-foot bin openings.

Of the several experimental bin fronts being tested at the Red River Valley Potato Research Center, East Grand Forks, Minn., a slotted front appears most promising. Planks 2 inches thick and 12 inches wide are spaced 12 inches apart, one over the other like shelves, across the front of the bin. With this design, the bin front offsets the natural fall of the potatoes. Open spaces wider than 12 inches between the planks would increase the angle at which the potatoes could fall into the openings, and would permit them to roll out of the bin.

When the bin is filled, potatoes roll onto the planks at a 45 degree angle and stop midway, or less, across this 12-inch, flat surface. A lip or cover attached on the outer edge of the planks prevents stray potatoes from rolling out of the bin. The open design alleviates the outward pressure from the potatoes against the bin front. Stress from the overhead weight of the potatoes is divided among the 2-inch-thick planks. The planks are easily installed in slots along the sides of the bin and are as easily removed when the bin is to be emptied.

Orr and Yaeger are testing planks of different materials and sizes and are also testing curved planks. ■

AGRISEARCH NOTES

Gloves Last Longer, Wear Better

Golf gloves that can be washed repeatedly and used for an entire season have been developed by ARS utilization scientists.

They're the latest item to be made of chrome-tanned leather retanned with the chemical glutaraldehyde in a process developed at the Eastern utilization research laboratory in Philadelphia. The process is widely used for shoe uppers, garments, and other leather products, and also used to tan shearlings for hospital bedpads and paint-roller covers (AGR. RES., December 1965, p. 8).

The encouraging results with golf gloves suggest the use of glutaraldehyde for tanning leather for work gloves and other gloves where perspiration resistance and launderability are important.

In wear tests at the Philadelphia laboratory, glutaraldehyde-tanned gloves were used for 8 months by 22 active golfers and were washed 5 to 8 times with warm water and soap or

Chemist S. J. Viola tests golf gloves that can be worn for an entire season. (Photo No. ST-1380-8)



detergent. All the golfers liked the gloves better than any they had worn previously. They found that manipulating the gloves after washing restored most of their original softness; and that the gloves dried without stiffening or cracking, no matter how wet they became with perspiration.

More Potato Plants per Tuber

ARS scientists have developed a propagation method that will help potato breeders and pathologists who want to get as many plants as possible from a single tuber.

Plant geneticist R. W. Buck, Jr. and horticulturist R. V. Akeley at Beltsville, Md., exposed tubers to light and air to force sprouts to grow. In this technique, called green-sprouting, they used whole tubers or cut each tuber into four pieces.

After green-sprouting, Buck and Akeley removed the sprouts; cut them into sections, each with a lateral or terminal bud, then planted the sprout pieces.

When tubers were cut into pieces before sprouting, each tuber yielded enough sprouts to produce an average of 31.2 potato plants. Sprouts from whole tubers produced an average of 20.2 plants per tuber.

The conventional method of planting seed cuttings yields 4 to 6 potato plants per tuber.

Sweetpotato Trimmings for Cattle

Dried sweetpotato trimmings, by-products of canning, look promising for use in beef cattle rations.

ARS nutritionists James Bond and P. A. Putnam fed 50-percent-concen-

trate rations to two groups of cattle at Beltsville, Md. One group got corn as the concentrate; the second group, sweetpotato trimmings.

Cattle fed sweetpotato trimmings gained about 80 percent as well as those on corn. Carcasses of cattle fed trimmings were of lower grade and yield, but taste panels rated their meat equal in palatability to meat from cattle fed corn.

The trials did not suggest a practical level for replacing grain with sweetpotato trimmings. Complete replacement is not desirable, the scientists say, but partial replacement might be worth trying if sweetpotato trimmings are available at low cost.

Trimmings are ordinarily available only during the canning season—the month of October and a week or two in September or November. Canneries in Louisiana, Arkansas, and some middle Atlantic States yield about 6,000 tons of trimmings per year, measured on a dry basis.

Trimmings should be ground before being mixed into cattle feed. Other than the cost of grinding, the cost of trimmings to stockmen located near canneries is likely to be low.



*Use Pesticides Safely
FOLLOW THE LABEL*